**How this investigation fits within the “Concept and Lesson Map”:**

**Overview for Investigation 1**

Students will conduct inquiry investigations attempting to balance several objects with different centers of gravity.

“If a strong force pushing one way is balanced by an equally strong force pushing the opposite way, the net force is zero, and a state of equilibrium is achieved.” (FOSS Investigation 1 folio)

**Overarching question(s) for this whole investigation:**

* How can we create equilibrium in different systems?

**How People Learn Key Finding #1: Preconceptions**

**Eliciting Students Ideas:**

Prior to starting investigation 1, take students to the gym. On tumbling mats, show students how to make a “tri-pod” stance (the posture taken prior to attempting a headstand—ask your PE specialist if you are unsure). Have a conversation about what they notice about balancing; what makes it challenging, what kind of words they use to describe forces, equilibrium, and balance. Have them make notes in their Science Notebooks documenting the experience, using pictures and words.

**Common Student Preconceptions:**

* Students generally regard the state of rest (balance) as fundamentally different from the state of motion. (Driver)
* Young children will state that an object will stop moving or fall over because it wants to. (Driver)
* For something to move it must have a constant force or push. (Driver)
* If a body is not moving there is no force acting on it. (Driver)

**How People Learn Key Finding #2: Facts/Concepts/Knowledge**

**WA State Content Standards “Science Domains” (EALR 4):**

* 2-3 PS1A Motion can be described as a change in position over a period of time.
* 2-3 PS1B There is always a force involved when something starts moving or changes its speed or direction of motion.

**WA State Content Standards “Science Domains” (EALRs 1-3):**

* 2-3 SYSA A *system* is a group of interacting parts that *form* a whole.
  + 2-3 INQA Scientific investigations are designed to gain knowledge about the natural world.
  + 2-3 INQC Inferences are based on observations.
  + 2-3 INQE Models are useful for understanding systems that are too big, too small, or too dangerous to study directly.
  + 2-3 INQF Scientists develop explanations, using observations (evidence) and what they already know about the world. Explanations should be based on evidence from investigations.

**Benchmarks for Science Literacy:**

* 1a When a science investigation is done the way it was done before, we expect to get a very similar result.
* 1a Science investigations generally work the same way in different places
* 1b People can often learn about things around them by just observing those things carefully, but sometimes they can learn more by doing something to the things and noting what happens.
* 1b Describing things as accurately as possible is important in science because it enables people to compare their observations with those of others.
* 1b When people give different descriptions of the same thing, it is usually a good idea to make some fresh observations instead of just arguing about who is right.
* 1c Everybody can do science and invent things and ideas
* **1c In doing science, it is often helpful to work with a team and to share findings with others. All team members should reach their own individual conclusions, however, about what the findings mean.**
* **4f Things move in many different ways, such as straight, zigzag, round and round, back and forth, and fast and slow.**
* **4f The way to change how something is moving is to give it a push or a pull.**
* **4g Things near the earth fall to the ground unless something holds them up.**
* 6d People can learn from each other by telling and listening, showing and watching, and imitating what others do.
* 9d Some things are more likely to happen than others. Some events can be predicted well and some cannot. Sometimes people aren’t sure what will happen because they don’t know everything that might be having an effect.
* 9e People are more likely to believe your ideas if you can give good reasons for them.
* 12a Raise questions about the world around them and be willing to seek answers to some of them by making careful observations and trying things out.
* 12d Draw pictures that correctly portray at least some features of the thing being described.
* 12e Ask “How do you know?” in appropriate situations and attempt reasonable answers when others ask them the same question.

**Key understandings for the teacher:**

* “Part 1: Balance” does not meet any of the EALR 4 (Content) standards at 2-3 grade.  The activity is engaging and FOSS suggests on page 7 that student explore balance with the Crayfish. After introducing Crayfish, this activity is an opportunity to support the students in understanding the EALR 2 (INQUIRY) standards. Teachers should have students ask explicit questions about changing the variables of the Trick Crayfish. Once asked, students should plan what they will try and draw a picture or write their ideas. Then predict what they think will happen. Observe what happens then draw or write what (conclusion) they observed.
* Part 2 is an opportunity to discuss a stable system. Introduce the idea that interacting parts form a whole. Changing these parts can change the system. By moving the counterbalances the system will change.
* Part 3 and 4 can also be used to support the inquiry EALR, 2, by having students identifying variables that they can change one at a time. Again go through the process of: asking a question, predicting what will happen, observing what happens, concluding if their observations match the students predictions why or why not.

**How People Learn Key Finding #3: Metacognition**

**Metacognition: How did my thinking change? What caused the change? How did I come to believe this?**

* After completing Parts 1, 3 and 4 students should review their predictions in their notebooks , and compare them to their findings to see how they were different or the same.
* After completing Investigation 1, students should return to the gym for the “tripod” exercise. Have a conversation about what they *now* notice about balancing; what makes it challenging, and what kind of words they use to describe forces, equilibrium, and balance. Have them make notes in their Science Notebooks documenting the experience, using pictures and words. Then return to their initial notebook entry and look for changes in their thinking. Try to help them pinpoint what activities or experiences caused those changes.

**Suggested Assessments for Student Understanding:**

* Part 1,3,4- Observe student work and examine student notebooks for understanding of the differences from their predictions and conclusions
* Part 2- Have students explain the parts of the Triangle and Arch systems.

**Additional Information**

**Materials and Student Management**

* FOSSWEB has an audio versions of the Big Book (<http://www.fossweb.com/modulesK-2/BalanceandMotion/index.html>)
* Have students explicitly make predictions, plans, and reflections in their Science Notebooks.
* There are opportunities to discuss other uses of the term “balanced.” The class could investigate nutritional balance as well as emotional or social balance (moods and feelings) as well.
* Mirette on the High Wire by [Emily Arnold McCully](http://www.amazon.com/Emily-Arnold-McCully/e/B001IOFDHM/ref=sr_ntt_srch_lnk_1?qid=1308852906&sr=1-1) and The Man who Walked Between the Towers by Mordicai Gerstein are picture books about tightrope walkers (and risk-takers).
* There are a variety of balancing toys that appear to defy laws of physics (like the pencil and wire). If you have any of these, they may be fun to spark early “balance” discussions.

**Timing Considerations**

* If your wire has lots of kinks in it from previous usage, the students may take more time to be successful at the pencil balancing.